DATA TRANSMITTING/RECEIVING APPARATUS AND METHOD IN WIRELESS SYSTEM

BACKGROUND OF THE INVENTION

[0001] This disclosure claims priority from Korean Patent Application No. 14101/2003, filed March 6, 2003, the subject matter of which is incorporated herein by reference.

1. Field of the Invention

[0002] Embodiments of the present invention may relate to a wireless system. More particularly, embodiments of the present invention may relate to a data transmitting/receiving apparatus and method in a wireless system that combines a transmission power controlling method and an erasure-error correcting method.

2. Background of Related Art

[0003] In a wireless system, when data is transmitted and received between a sending end and a receiving end, the received data is frequently damaged when a transmission channel state becomes bad (or damaged) due to a time difference according to geographical features or in each path and spatial environment factors. In order to compensate for such damage occurring at the channel in data transmission and reception, a transmission power controlling method or an error correcting method may be used.

[0004] In the transmission power controlling method, the sending end and the receiving end may raise or drop the transmission power according to a channel situation (or based on channel performance) so that every terminal user can receive a same strength of a radio wave. This may help guarantee a uniform quality of service (QoS). More specifically, if the channel is in a good state (hereafter also called good), the transmission power may be lowered, whereas if the channel is not in a good state (hereafter also called bad), the transmission power may be raised.

[0005] The error correcting method may restore damaged received data as it occurs at the receiving end, for which a turbo-coding method or a block encoding method may be used.

[0006] However, since either the transmission power adjusting method or the error correcting method are separately used, advantages and disadvantages of both methods are not suitably adopted.

SUMMARY OF THE INVENTION

[0007] An object of the invention is to solve at least the above problems and/or disadvantages and to provide at least the advantages described hereinafter.

[0008] Embodiments of the present invention may provide a data transmitting/ receiving apparatus and method in a wireless system capable of enhancing performance by coupling (or combining) a transmission power controlling method and an erasure-error correction method.

[0009] A data transmission apparatus in a wireless system may be provided that includes a Q-ary encoding unit to block-encode data to be transmitted and a modulating unit to receive each Q-ary symbol from the Q-ary encoding unit. The Q-ary encoding unit may modulate and output a modulated Q-ary symbol. An amplifying unit may amplify each modulated data to as high a target power for a channel gain and output the amplified data.

[0010] A data transmitting method may also be provided in a wireless system. This may include comparing channel gains in each sub-channel of transmission data with a prescribed (or predetermined) reference value to classify a channel as 'good' or 'bad'. If the channel is classified as 'bad', the corresponding data symbol is erased and transmission power is controlled to be '0' to stop data transmission, whereas if the channel is classified as 'good,' transmission power of all the sub-channels is controlled to be 'P,' for example.

[0011] Embodiments of the present invention may also provide a data receiving apparatus in a wireless system that includes a demodulating unit for demodulating a signal received by each sub-channel and outputting a Q-ary symbol. A Q-ary decoding unit may perform a block decoding on a Q-ary symbol of each sub-channel output from the demodulating unit.

[0012] A data receiving method may also be provided in a wireless system that includes comparing channel gains of transmission data for each sub-channel with a prescribed (or predetermined) reference value to classify a channel as 'good' or 'bad'.

If the channel is in the 'bad' state, it may be determined that a corresponding data symbol has been erased and the symbol is stored. On the other hand, if the channel is in a 'good' state, a demodulation may be performed on the data symbol and the demodulated symbol may be stored. The stored symbols may be collected to form a packet unit. A demodulation may be performed according to an erasure-error correction method to restore data.

[0013] The channel gain value may be shared by channels, detected by a receiving end and informed to a sending end through a feedback channel, or estimated through a value detected in a previous data transmission.

[0014] Additional advantages, objects, features and embodiments of the present invention may be set forth in part in the description that follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The following represents brief descriptions of the drawings in which like reference numerals refer to like elements and wherein:

[0016] Figure 1 illustrates a construction of a data transmitter in a wireless system in accordance with an example embodiment of the present invention;

[0017] Figure 2 is a flow chart of a data transmitting method in a wireless system in accordance with an example embodiment of the present invention;

[0018] Figure 3 illustrates a data receiving apparatus in a wireless system in accordance with an example embodiment of the present invention; and

[0019] Figure 4 is a flow chart of a data receiving method in a wireless system in accordance with an example embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] Figure 1 illustrates a construction of a data transmitter in a wireless system in accordance with an example embodiment of the present invention. Other embodiments and configurations are also within the scope of the present invention.

[0021] As shown in Figure 1, a data transmitting apparatus in a wireless system may include a Q-ary encoding unit 10, a modulating unit 20 and an amplifying unit 30. The Q-ary encoding unit 10 may block-encode data to be transmitted. The modulating unit 20 may modulate each Q-ary symbol output from the Q-ary encoding unit 10 and output sub-channel data. The amplifying unit 30 may amplify each modulated sub-channel data to as high a target power for a channel gain and output the amplified data.

[0022] The Q-ary encoding unit 10 may include a Q-ary block encoder 11, an interleaver 12 and a serial-to-parallel converter 13. The Q-ary block encoder 11 may add a redundancy to an information sequence block of to-be-transmitted data and map the data to a code sequence block having a greater number of bits. The interleaver 12 may interleave the mapped data symbol to prevent an error on a

channel. The serial-to-parallel converter 13 may convert the interleaved serial Q-ary code symbol into an M-parallel bit and output the bits to each sub-channel. 'Q' may be a multiple of '2' and 'M' is $\log_2 Q$ and indicates a number of sub-channels. For example, in an 8-ary in which Q is 8, since 'M' is $\log_2 8=3$, the number of sub-channels may be 3.

[0023] The modulating unit 20 may include a modulator for each of the sub-channels to modulate Q-ary symbols of each Q-ary symbol and output them.

[0024] The amplifying unit 30 may include an amplifier for each of the sub-channels to amplify each sub-channel to a target power for a channel gain and output the amplified signals.

[0025] Figure 2 is a flow chart of a data transmitting method in a wireless system in accordance with an example embodiment of the present invention. Other operations, orders of operations and embodiments are also within the scope of the present invention.

[0026] Figure 2 shows that a sending end detects channel gains (γ_i) of to-be-transmitted data for each sub-channel (step S10). The channel gains (γ_i) are obtained through a feedback channel by a receiving end, obtained by being shared between channels, or estimated from a value detected in a previous data transmission.

[0027] The detected channel gains (γ_i) may be compared with a certain (or predetermined) reference value (γ_0) (step S20). If one channel gain for all the sub-channels is smaller than the reference value (γ_0), then a corresponding channel is

determined to be in a bad state and classified as 'BAD' (step S30). A corresponding data symbol is erased (step S40) and data transmission may be interrupted by making the transmission power '0' (step S50). In other words, it may be determined that there would be an error in data transmission, so therefore the data transmission is not even made. Even though the sending end does not transmit data, the receiving end can estimate the data that has not been transmitted through sharing information among wireless channels.

[0028] If, however, all the channel gains (γ_i) in every sub-channel are greater than or the same as the reference value (γ_0), the corresponding channel is determined to be in a good state and classified as 'GOOD' (step S60). The transmission power of the corresponding channel is set as 'P' (step S70). 'P' may be a constant or a function related to the channel gain (γ_i) and may include a target power value calculated as the receiving end feeds back a measured channel gain to the sending end. The above process may be simplified as follows:

[0029] $(\gamma_i) < (\gamma_0) \rightarrow$ BAD $\rightarrow$ erasing corresponding symbol and transmission power = 0 (for some, i, $i \in \{1, 2, \ldots, M\}$)

[0030] $(\gamma_i) \geq (\gamma_0) \rightarrow$ GOOD $\rightarrow$ not erasing corresponding symbol and transmission power = P (for all i, $i \in \{1, 2, \ldots, M\}$), wherein 'P' is a constant or a function of γ_i.

[0031] Namely, in consideration of an ON-OFF channel inversion power control method, if a channel condition is not good, the transmission power may be allocated to '0' to prevent data transmission, and for an error generated in this case, the corresponding symbol may be designated as an erasure symbol to thereby enhance a correction capability of a block code. The erasure-error correction may be better than a general error correction, and the block code can correct double erasure symbols of the error.

[0032] Figure 3 illustrates a data receiving apparatus in a wireless system in accordance with an example embodiment of the present invention. Other embodiments and configurations are also within the scope of the present invention.

[0033] As shown in Figure 3, a data receiving apparatus in the wireless system may include a demodulating unit 100 and a Q-ary decoding unit 200. The demodulating unit 100 may demodulate a signal received by each sub-channel and output a Q-ary symbol. A Q-ary decoding unit 200 may perform a block decoding on the Q-ary symbol of each sub-channel output from the demodulating unit 100.

[0034] The demodulating unit 100 may include a plurality of demodulators for all of the sub-channels so as to demodulate signals received by each sub-channel and appropriately output the signals.

[0035] The Q-ary decoding unit 200 may include a parallel-to-serial converter 201 for converting Q-ary symbols that are input in parallel bits for the plurality of sub-channels into serial bit Q-ary symbols. The parallel-to-serial converter 201 may

output the bits to a deinterleaver 202 for performing a deinterleaving on the Q-ary symbols. A Q-ary block decoder 203 may perform an erasure-error correction on the deinterleaved symbol data to restore transmission data.

[0036] Figure 4 is a flow chart of a data receiving method in a wireless system in accordance with an example embodiment of the present invention. Other operations, orders of operations and embodiments are also within the scope of the present invention.

[0037] In Figure 4, channel gains (γ) of received data in each sub-channel are detected (step S110). The detected channel gains (γ_i) are compared with a prescribed (or predetermined) reference value (γ_0) (step S120).

[0038] If even one channel gain of the plurality of sub-channels is smaller than the reference value (γ_0), a corresponding channel is determined to be in a bad state and classified as 'BAD' (step S130). If, however, all the channel gains (γ_i) of every sub-channel are greater than or the same as the reference value (γ_0), the corresponding channel is determined to be in a good state and classified as 'GOOD' (step S140).

[0039] If the classified channel state is 'BAD', it is determined the corresponding data symbol has been erased and data is stored (step S150). If the classified channel state is 'GOOD', a demodulation is performed on a corresponding data symbol and the data is stored (step 160).

[0040] Thereafter, when data are collected to form a packet (step S170), a demodulation is performed according to the erasure-error correction to restore data in the packet unit (step S180).

[0041] The above-described data transmitting/receiving apparatus and method in the wireless system has many advantages. For example, by considering the ON-OFF channel inversion power controlling method, if a channel is in a bad state, transmission power can be saved, and because each user controls transmission power independently with respect to other users, an average multiple access interference can be reduced.

[0042] In addition, since a symbol having a high error occurrence probability is designated as an erasure symbol through channel gains and the receiving end restores data through demodulation according to the erasure-error correction method, the correction capability of the block code can be enhanced.

[0043] The foregoing embodiments, advantages and objects are merely exemplary and are not to be construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. The above description is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.